

# How ~~Can We Better~~ Are Capturing Flash Droughts in the U.S. Drought Monitor Better?

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# What is “Flash” Drought?

Like drought, there is ***no universal definition for flash drought***...but it is not necessarily a “new” term...

- 2001 AP/USA Today/NPR quotes mainstreamed the term
- First known reference (Svoboda et al. BAMS 2002)
- Contemporary references (Mo/Lettenmaier 2015 + 2016; Otkin et al. 2017)

***Rapidly*** developing ***intraseasonal*** drought events that are termed as ***“flash droughts”*** are often accompanied by ***extreme heat, low soil moisture, high winds, large VPD and high evapotranspiration (ET)***

- *It’s about rapid “ONSET/INTENSIFICATION”! May go on to linger weeks, months or years....*
- *Typically develop as “growing season” droughts, not COLD/SNOW droughts*
- *Timing, timing, timing...*

# Flash Drought – Another Drought Type?

- The term's usage increased greatly in 2011 and 2012 in response to two drought events that developed very rapidly across the central and southern U.S.
- Despite its widespread use, a *formal definition currently does not exist*
- *Two approaches* have been used to identify “flash droughts”
  - Unusually rapid rate of intensification
  - Implicit focus on short duration
- *Conflicting approaches introduce ambiguity that affects our ability to monitor and forecast these events*

# U.S. Drought Monitor USDA Southern Plains Climate Hub



**July 4, 2000**  
(Released Thursday, Jul. 6, 2000)  
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	56.52	43.38	13.07	1.82	0.36	0.00
Last Week 06-27-2000	52.39	47.61	26.16	9.73	0.00	0.00
3 Months Ago 04-04-2000	39.13	60.87	44.79	32.89	0.00	0.00
Start of Calendar Year 01-04-2000	23.79	76.21	46.39	32.75	0.00	0.00
Start of Water Year	-	-	-	-	-	-
One Year Ago	-	-	-	-	-	-

## Intensity

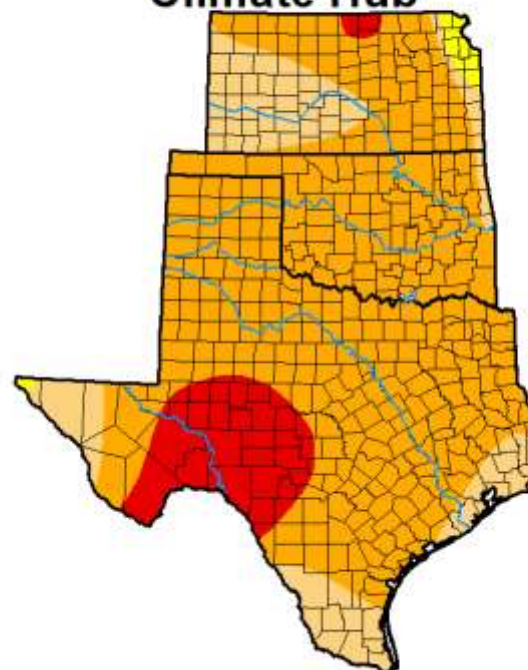
D0 Abnormally Dry      D3 Extreme Drought  
D1 Moderate Drought      D4 Exceptional Drought

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# U.S. Drought Monitor USDA Southern Plains Climate Hub



**October 3, 2000**  
(Released Thursday, Oct. 5, 2000)  
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	99.00	83.24	10.21	0.00
Last Week 09-26-2000	0.00	100.00	94.38	70.11	10.21	0.00
3 Months Ago 07-04-2000	56.52	43.38	13.07	1.82	0.36	0.00
Start of Calendar Year 01-04-2000	-	-	-	-	-	-
Start of Water Year 09-28-2000	0.00	100.00	94.38	70.11	10.21	0.00
One Year Ago	-	-	-	-	-	-

## Intensity

D0 Abnormally Dry      D3 Extreme Drought  
D1 Moderate Drought      D4 Exceptional Drought  
D2 Severe Drought

The Drought Monitor focuses on broad-scale conditions.  
Local conditions may vary. See accompanying text summary  
for forecast statements.

Author:  
Staff

National Drought Mitigation Center



<http://droughtmonitor.unl.edu/>



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FLASH DROUGHTS: A REVIEW AND ASSESSMENT OF THE CHALLENGE...

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## FLASH DROUGHTS: A REVIEW AND ASSESSMENT OF THE CHALLENGES IMPOSED BY RAPID ONSET DROUGHTS IN THE UNITED STATES

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# Flash Drought – Proposed General Definition

- We propose that “flash droughts” should be viewed as a subset of all droughts that are **distinguished solely by their rapid rate of intensification**
- This definition can be seamlessly **applied to all drought types**
- **Our proposed definition has two basic requirements:**
  - A given drought index must change much more rapidly than normal (e.g., the “flash” part of the definition)
  - Drought index must fall below the 20<sup>th</sup> percentile (e.g., “drought” according to the USDM classification scheme)
- Definition ***excludes short periods of anomalous conditions*** that do not lead to drought impacts



# U.S. Seasonal Drought Outlook

## Drought Tendency During the Valid Period

Valid for May 17 - August 31, 2012

Released May 17, 2012

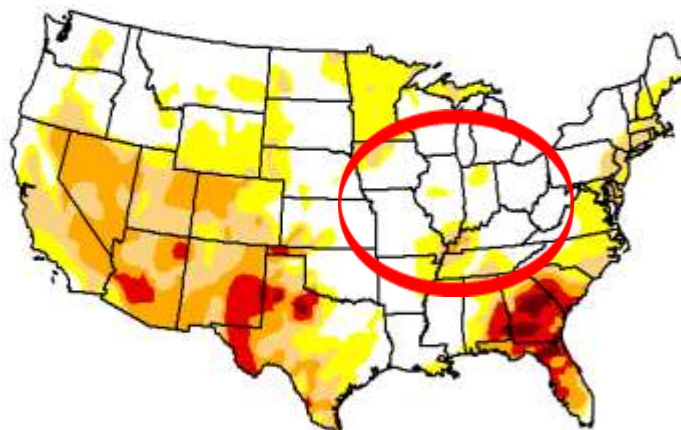


### KEY:

- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts large-scale trend by short- and long-range -- such as individual stor Use caution for applicati "Ongoing" drought areas For weekly drought upda areas imply at least a 1- but do not necessarily in

## U.S. Drought Monitor CONUS



May 15, 2012

(Released Thursday, May. 17, 2012)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	45.21	54.79	33.64	18.39	5.71	1.02
Last Week 5/8/2012	43.88	56.12	35.88	19.65	6.77	1.61
3 Months Ago 2/14/2012	42.67	57.33	37.82	17.98	9.32	3.22
Start of Calendar Year 1/3/2012	50.41	49.59	31.00	18.83	10.18	3.32
Start of Water Year 5/27/2011	56.45	43.55	29.13	23.44	17.80	11.37
One Year Ago 5/17/2011	67.69	32.31	26.35	20.68	13.18	6.04

### Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

### Author(s):

Brad Rippey

U.S. Department of Agriculture



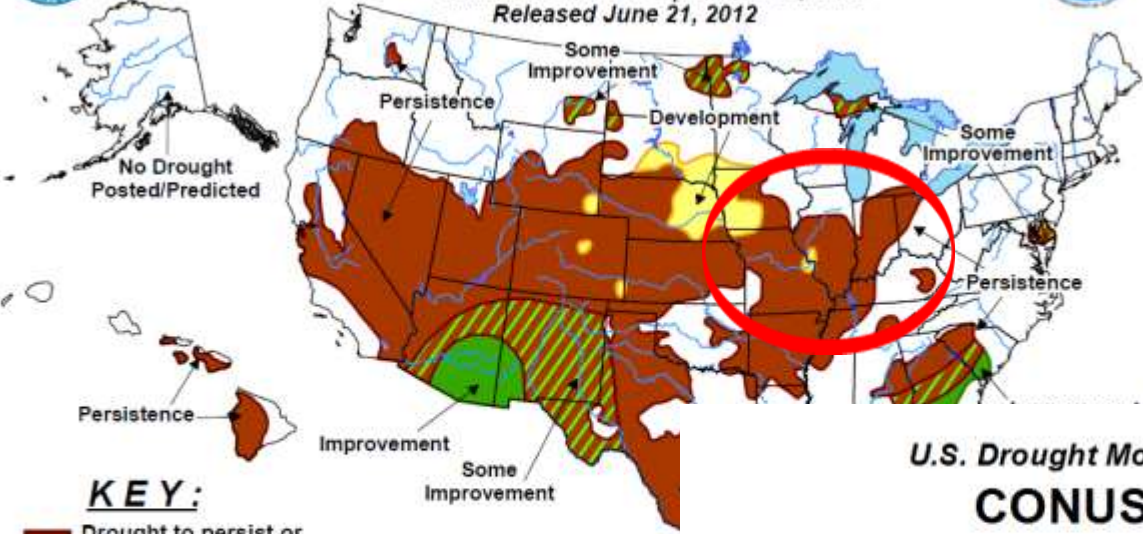
<http://droughtmonitor.unl.edu/>



# U.S. Seasonal Drought Outlook

## Drought Tendency During the Valid Period

Valid for June 21 - September 30, 2012  
Released June 21, 2012

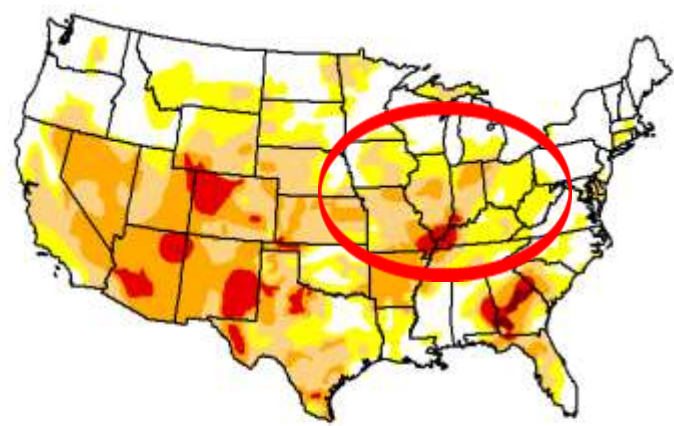


### KEY:

- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts large-scale trends based on short- and long-range statistical analysis -- such as individual storms -- cannot be used for applications -- such as "Ongoing" drought areas are approximate. For weekly drought updates, see the local news. Areas imply at least a 1-category improvement but do not necessarily imply drought end.

## U.S. Drought Monitor CONUS



June 19, 2012  
(Released Thursday, Jun. 21, 2012)  
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	31.22	66.78	45.72	24.27	5.19	0.29
Last Week 6/12/2012	37.47	62.53	39.68	19.14	3.92	0.29
3 Months Ago 3/19/2012	43.91	56.09	38.31	19.19	6.08	2.21
Start of Calendar Year 1/1/2012	50.41	49.59	31.90	18.83	10.18	3.32
Start of Water Year 10/1/2011	56.45	43.55	29.13	23.44	17.80	11.37
One Year Ago 6/21/2011	67.29	32.71	27.29	22.36	18.00	11.84

**Intensity:**  
D0 Abnormally Dry  
D1 Moderate Drought  
D2 Severe Drought  
D3 Extreme Drought  
D4 Exceptional Drought

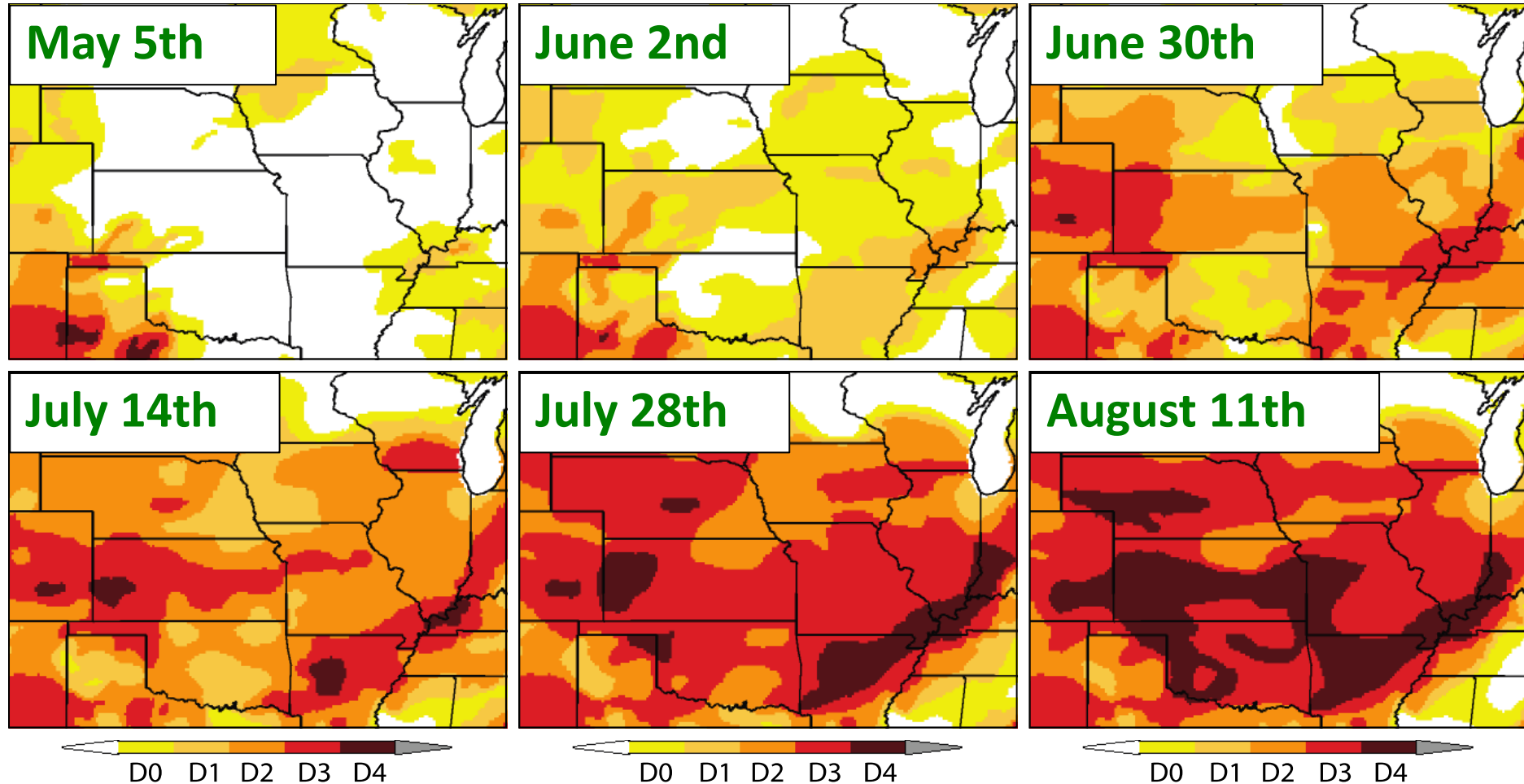
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author(s):  
Richard Heim  
NCDC/NOAA





# What Does Flash Drought Look Like?



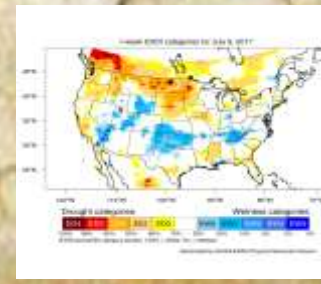
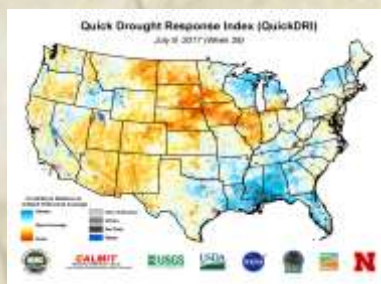
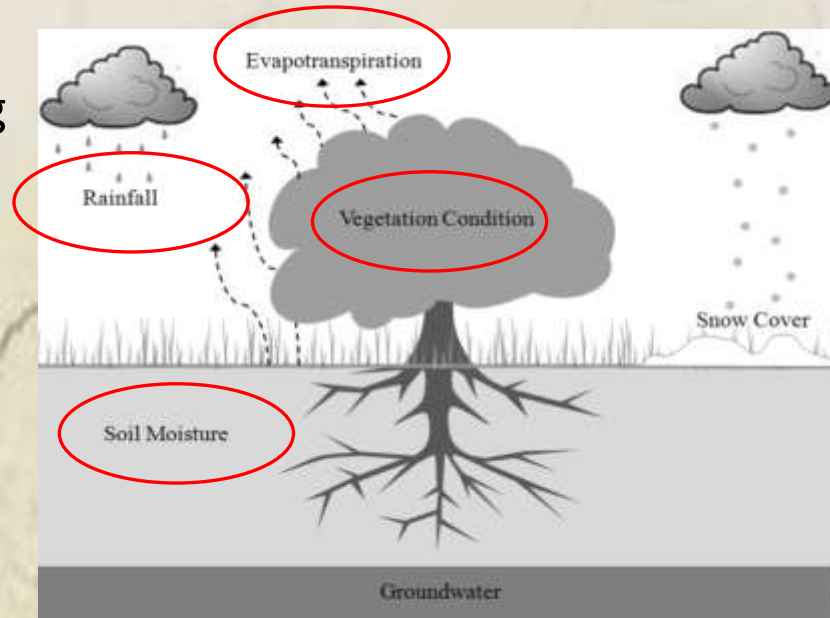
- During 2012, the U.S. Drought Monitor indicated that extreme drought conditions (D2-D4) rapidly developed across the central U.S. in response to extreme heat and dry weather

# Emerging Satellite-based Observations and Products

Over just the past 5+ years, a number of satellite remote sensing-based tools and **products characterizing different parts of the hydrologic cycle that influence drought conditions** allowing new composite drought indicators to be developed.

## Examples

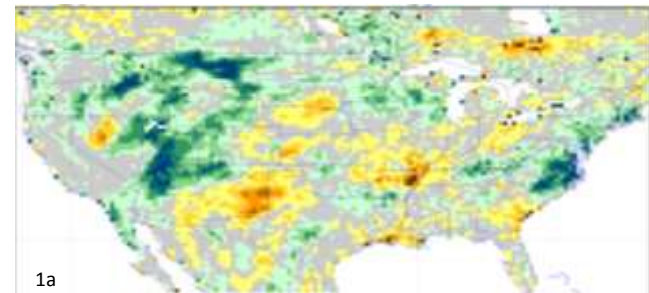
- Evaporative Stress Index (ESI)
- Quick Drought Response Index (QuickDRI)
- Evaporative Demand Drought Index (EDDI)
- GRACE soil moisture and groundwater anomalies
- Vegetation Drought Response Index (VegDRI)



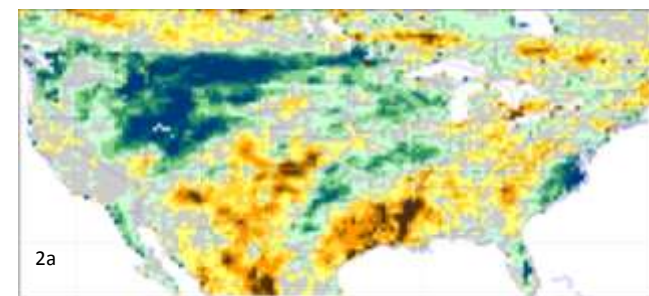
# **EA Focus: Evaluation of SMAP Soil Moisture Products for Operational Drought Monitoring: Potential Impact on the U.S. Drought Monitor**

*SMAP Early Adopter: National Drought Mitigation Center, Mark Svoboda and Brian Wardlaw*

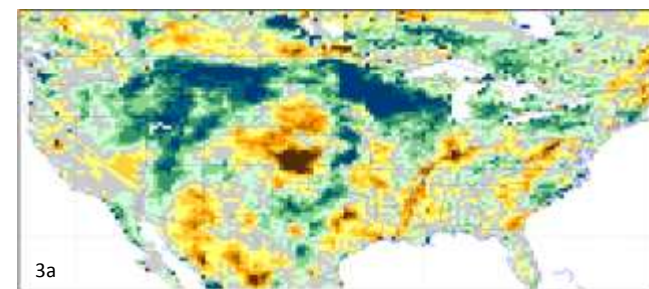
## Evolution of Soil Moisture Change Maps From SMAP



Difference between this week and previous week



Difference between this week and 1 month ago



Difference between this week and 3 months ago

## US Drought Monitor Change Maps



Change from past week

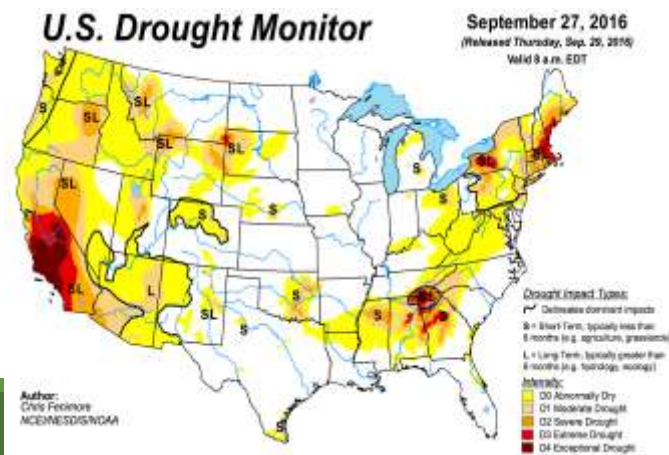


Change over the past month



Change over the past 3 months

**The National Drought Mitigation Center (NDMC)** is implementing SMAP data to derive relevant statistics and provide them to the Authors (State Climatologists) to assist them delineate the drought map, and understand the drought severity and recovery. The Soil Moisture Change Maps clearly corresponds with the USDM Change Maps, and this demonstrates how soil moisture evolution over time and space can be used for drought propagation and mitigation.





# Final Thoughts

- ***“Flash droughts,”*** or rapid onset droughts, on the order of weeks as opposed to months or years, ***are still not well understood.***
- Seeing a ***shift toward more development of remotely sensed, modeled, gridded and/or combined/composite indicators*** (e.g. NLDAS, MDSI, QuickDRI, ESI, EDDI, SMAP...) being integrated into the USDM ***(and stand alone)*** as well as regional drought early warning capacity via the National Integrated Drought Information System (NIDIS) and USDM expert list server community ***(425+)***
- ***Strength of USDM*** is found in its ability to ***integrate and ingest new data sources*** as they mature and come on-line after a transparent vetting period...
  - Helping ***increase resolution (spatial + temporal) and accuracy of the USDM***
- ***Increasing “flash drought” detection capacity*** within the USDM (e.g. 2016 in Black Hills and the Southeast, 2017 High Plains)
  - We didn’t have this capacity (w/in the USDM) for the iconic 2012 flash drought event



**Thank You!  
Questions?**

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